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ABSTRACT

Designing a distance learning classroom requires integration of educational goals and philosophy with technology and ergonomics. The technological challenge and key to designing effective distance learning and multimedia classrooms is creating an environment in which the participants--students, and teacher--may easily interact with instructional materials. Based on the experiences of California State University, Fresno (CSUF) and California State University, Hayward (CSUH), the design challenges and solutions for large compressed video and multimedia classrooms are illustrated. Various options for facilities accommodating from 48 to 184 students are examined for the inclusion of state of the art control systems with multimedia capability. General design considerations include: site and spatial relationships, imaging, lighting, acoustics, mechanical systems, and electrical and communication systems. It is essential that planners determine the optimum mix and configuration of teaching facilities prior to beginning any classroom project. An appendix provides a list of equipment for the two interactive CSUF classrooms described, as well as the video network designs, floor plan, and equipment layout. In addition, a packet of information on the CSUH distance learning classroom design is included. (Contains 12 references.) (AEF)

Technological Challenges: Designing Large Compressed Video and Multimedia Classrooms

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Technological Challenges: Designing Large Compressed Video and Multimedia Classrooms

As telecommunication technology has become more sophisticated and pervasive, distance learning has become increasingly employed by educational institutions and the corporate sector. The flexibility and responsiveness of distance learning offers solutions to many issues facing education and training. Distance learning is a way to share resources of a specialized teacher and offer students the opportunity to attend otherwise unavailable classes. Mediated interaction can take a variety of forms depending on the technology used to bridge the space-time gap between the learner and the instructor. Existing and emerging digital technologies, such as multimedia tools, are being readily employed in distance education.

When a system of distance education is designed, all aspects of the educational process must be considered and addressed, including the technology to mediate communication between teacher and student (Garrison, 1989). Designing a distance learning classroom requires integration of educational goals and philosophy with technology and ergonomics. The technological challenge and key to designing effective distance learning and multimedia classrooms is creating an environment in which the participants—students, teacher, and instructional materials—may easily interact. There is no one ideal classroom configuration, as there are multiple factors which must be taken into account in designing a classroom.

Today's changing educational environment also requires consideration in classroom design. Trends in education towards collaborative learning and an increasing change in the instructor's role from the disseminator of information to becoming a facilitator of learning must be taken into account when making plans for distant learning classrooms. The traditional classroom with the instructor in front facing a group of students is not necessarily the best design in today's environment. A design that is flexible enough to accommodate differences in instructor preference, the type of course being taught, number of students, and curriculum design will result in a learning environment effective for both instructor and students both on and off campus.

Traditional classroom design documents (e.g., Allen's *Design of General-Purpose Classrooms and Lecture Halls*, 1991) point to general considerations relevant for any classroom, including distance learning and multimedia facilities. There are three basic requirement for students in classrooms, regardless of the method of instruction in which they participate. These are: first, to easily see anything presented visually; second, to easily hear any audible presentation free from noises outside the room or building

equipment noises inside the room; and third, to be physically comfortable, particularly in the area of adequate air circulation and fresh-air quality.

Assuring the students' ability to see and hear the instructor, the students in other locations, and multimedia material presented is critical in creating an effective distance learning environment. The students are in two categories: the local students who are located with the instructor and the remote students who are often by themselves in distant locations. If the students don't see and hear each other periodically, interaction between students is very difficult to stimulate. Interaction between sites helps create a unified class environment rather than a singular, "remote" class at each site.

Several design approaches may be utilized to create an interactive classroom. One technique to facilitate integrating the sites is to physically place the instructor with the students. In this case, the imaging devices (cameras and monitoring equipment) are in front of both students and the instructor. A second technique is to physically place the instructor facing the local classroom students, but periodically switching the transmitted image view from the instructor to the local students. A third technique is to place a separate or integrated display device specifically for the remote site students to be viewed irrespective of the position of the instructor and local students. All approaches assume full two-way audio with echo cancellation, and most multiple site configurations assume voice-activated switching.

Achieving discernible audio is one of the most challenging elements in creating an effective distance learning environment (Greg & Persichitte, 1992). An issue that must be addressed with voice-activated multipoint systems is that the noise from the classroom will switch the system to the classroom generating noise, rather than focusing on the instructor or student speaking. The choice of type and placement of microphones and speakers is critical to assure that the instructor and all students will be heard. Controlling echo has been a daily challenge for distance learning educators and technicians, but good acoustical design and ambient noise level considerations as well as critical equipment specifications will avoid ongoing difficulties.

Distance learning rooms should be arranged to accommodate instructor preferences and styles, requiring flexible seating in most room designs. Microphone selection and placement is key to allowing flexibility in moving furniture around. Some instructors prefer the traditional arrangement of facing their students. Others prefer to sit with their students as a discussion facilitator rather than a lecturer. Many instructors assign in-class small group discussions. Some instructors use a combination of techniques, even in large class sections. Classroom designs which are arranged with displays and cameras in front and in back of the room allow more instructor flexibility.

Placement of furniture and equipment to assure a good view of imaging devices and facilitate interaction between the students is also important. In a distance learning classroom, the displays are used not only for students and instructors to view each other, but also for all participants to view graphics, documents, realia, multimedia and other visual materials presented by either the instructor or any of the on or off campus students. Thus the displays must be placed within easy view of all students.

While much information has been printed on small group video conferencing (e.g., USWEST's *MediaConferencing: Classroom Designs for Education*, 1993 and *Apple's Standards for Videoconferencing Systems*, 1992), little information is available on larger capacity classrooms. This session will discuss the design challenges and illustrates the solutions for large compressed video and multimedia classrooms based upon the experiences of two state universities engaged in distance learning. Various options for facilities, ranging from 48 to 184 students, will be examined for the inclusion of state-of-the-art control systems with multimedia capability. Architectural design considerations for audio and imaging will be explored and shown.

Some General Considerations

Site and Spatial Relationships

The center of interest in the room should be the learning environment consisting of the instructor, student and instructional resources. Nothing else in the room should compete for attention. Therefore, all the equipment, colors, patterns, materials, and shapes in the room should be designed and finished accordingly (CSU Media Directors, 1991).

Room Geometry. The ideal classroom dimension is length equals one and one-half times the width. Wider rooms create unacceptable viewing angles, and shorter rooms have the potential for creating acoustical problems. Large classrooms should have fan-shaped seating (Allen, 1991) or U-shaped seating (Aiken & Hawley, 1995), if dedicated student viewing devices (computers) are provided.

Entrances, Exits, and Lobby Areas. The principal entrances and exits for large rooms should be in the rear section of the room, but if at all possible, should not be in the rear wall in order to avoid screen reflections.. All entrances or exits should be large double doors so as to reduce the impact of exterior noise and sharp temperature variations. A lobby space may also provide further sound and environmental isolation.

Windows. Exclusion of all natural light when using window shades is often a problem. Windows also represent an acoustical problem if there is significant amount of noise potential from the exterior areas around the building. Therefore, all multimedia

rooms should be completely free of windows. In cases where existing halls do have windows, opaque drapes, operated electromechanically, are indicated. The drapes must be hung with six-inch overhang, and insulated with light-tight side channels.

Control, Network , and Projection Booth Area. All large multimedia and distance learning facilities should have a control, network and projection both area. The booth provides sound separation to 20 decibels between machine operation noise and the audience, space for terminal equipment, network servers, compressed video units, operational personnel, and storage. The minimum practical size for a booth area is 12 feet wide by 8 feet deep (CSU Media Directors, 1991).

Imaging

The need for multiple imaging surfaces within classrooms is increasing as more technology is being applied to the teaching-learning process. The standard that held true in the past of one screen mounted in the center of the room is no longer adequate. Ideally, every student should be provided with an imaging device. Minimum viewing angles dictate that no student view an image from more than 30 degrees to the right or left from a line perpendicular to the center of the screen. Screen center line should not be more than 15 degrees above or below the viewer's straight line of sight. Economics usually dictate several large-screen display devices for high capacity facilities:

Large Projection Systems and Screens. Optical projection, films and slides have very high resolution images resulting in a formula of distance from the screen to the farthest viewer of six times the screen width. While constantly improving, electronic projection systems provide 12 to 25 percent less resolution than optical projection. This is particularly critical in computer projection which may be in large part or totally made up of text. For multiple image showing (several images within one larger screen), the total image size should be two to three times the minimum width so that each projected image meets the minimum 6-W formula above. Because of these factors, it is recommend the ratio of screen size to distance to the farthest viewer be set to 1:4 at a minimum. In a room where the farthest viewer is 40 feet from the screen, a 10-foot wide image is required.

Television Screens. Full visual resolution of the detail of conventional television is available when the image is viewed at a distance equal to six or seven times the height of the display. A viewing ratio of four to eight times the height of the display is usually assumed in designing for broadcast television (Inglis, 1993). Indeed, a substantial amount of research gathered over the years has established that the average U. S. Consumer views the television receiver from a distance of approximately seven picture heights (Whitaker, 1994). For example, a 30-inch diagonal screen with the National Television Systems Committee (NTSC) standard (18 inches high by 24 inches wide) is

viewed at 10.5 feet. At this viewing distance, most of the NTSC artifacts are invisible, with the possible exception of cross color. Consequently the viewer is presented with a narrow angle of view, on the order of 10 degrees. The image has now become a small window. Thus the primary limitation of current video systems is, therefore, one of image size. Old rules for determining the farthest viewer, one foot per diagonal inch, need to be immediately discarded in favor of the more correct, 8-H formula. This will become even more critical as high definition systems are being designed for viewing from a distance of three time the picture height.

Lighting

Because of the lack of natural lighting and the use of instructional technology, lighting is a critical factor in large facilities. Lighting must be sufficient for video imaging, avoid reflections and glare on screens and imaging devices, and provide minimal levels for note taking. To achieve satisfactory image quality for a camera, a light intensity of 85-95 vertical foot candles at seated eye level is required (*Apple's Standards for Videoconferencing Systems*, 1992). The light level should be capable of being reduced to 10 foot candles at the student station while maintaining the higher level at the instructor's station without impact on the quality of the picture on the various display devices. Switches and control of dimming should be provided at the instruction area, control or operations booth , and entrances to the room (CSU Media Directors, 1991; Allen, 1991).

Acoustics

The ideal Noise Criteria (NC) for a multimedia and distance learning facility is 25. By way of comparison, a typical quiet office has a rating of NC 30-35, and this should be considered the minimally acceptable level. The Sound Transmission Class (STC) rating for walls and ceiling should be 55. Solid core or acoustically rated steel doors must be used (40-50 STC), and floors should be carpeted. Ventilation systems should be designed for NC 20 with a maximum air velocity at the diffuser neck of 300 feet per minute. The rear wall should be covered in sound-absorbing material entirely, and the side and front walls should be covered to a minimum of 50 percent. Ceilings should be fitted with sound-absorbing tile with an Noise Reduction Coefficient (NRC) rating of 0.90. (*Apple's Standards for Videoconferencing Systems*, 1992; CSU Media Directors, 1991)

Mechanical Systems

In general, all mechanical systems must be free from serious or distracting acoustical problems. Elevators or equipment rooms should not be collocated adjacent to the facility. Factors that have been identified in the design of a quiet operating system include fans remote from the room, low velocity of air within the room, acoustically lined

ducts, and diffusers that are appropriate to the installation No mechanical system should exceed a background noise of more than NC 20-25. Systems require not only careful design, but competent installation, balancing, and a regular maintenance program once installed (Allen, 1991).

Electrical and Telecommunication Systems

All classrooms should have adequate electrical power and signaling conduit to serve the needs of faculty performing demonstrations and in facilitating the use of various instructional technologies programmed for inclusion within the space. The more complex are the networked and new media resources, the more complicated are the signaling and power requirements. Networked student stations are rapidly becoming the norm in classrooms (Christopher, 1995; Aiken & Hawley, 1995), and provision must be made for new applications in the future.

Electrical. All electrical services should be protected from surges and spikes. The room should have a minimum of two dedicated 20-amp circuits. One of these should serve the instructor's workstation and the other should serve the imaging and display equipment on the wall and ceiling. The control, network, and projection booth area should have approximately 150 amp service. All electrical circuits and signal conduit should have the same ground potential and reference, and there should be no major building equipment on the side of the power transformer that feeds these circuits (CSU Media Directors, 1991)

Telecommunications. Voice, Video, and Data Services should be provided from the main building telecommunications room to the closest satellite wiring closet, and finally, to the classroom facility. Pathways and conduits must be designed as a specific part of an overall telecommunications infrastructure plan, not as a system or technology-specific component. At least two four-inch conduits should be dedicated for a classroom facility, and a one and one-half inch conduit will be needed for connecting the faculty teaching station and the room display system. All telecommunication station outlets should be served by a minimum of a one and one-quarter inch signaling conduit (CSU Telecommunications Infrastructure Planning Guidelines, 1993).

California State University, Fresno (CSUF)

The Academic Innovation Center, in conjunction with the School of Extended Education and academic departments, uses a variety of telecommunications systems to deliver credit and noncredit courses and educational programs within the Central San Joaquin Valley. The first courses by one-way video and two-way audio using the microwave-based Instructional Television Fixed Service were televised during the fall semester of 1987. Academic years' 1987-88 and 1988-89 piloted the system with only one remote receiving

site at the University's College of the Sequoias Learning Center and with only two to three courses being offered per semester. Since that time, a dedicated microwave system linking CSUF with sister California State University (CSU) campuses to the north has been added and 19 additional remote sites have been established (Hart, 1992). These remote receiving sites at Community Colleges, High Schools, and Hospitals, are currently participating in some 20 to 28 course offerings per semester. Over 1000 students per year are enrolled and administrated by the Distance Learning Program.

Beginning in the fall of 1993, the distance learning system was expanded for two-way compressed video interactivity between instructors and students. Using a series of digital CODEC (COder-DECoder) units, the curriculum was enhanced to provide real-time, audio-video interaction to advance the teaching-learning environment. This was accomplished first to the most inaccessible receiving site at Yosemite High School and then to the primary receiving site at the College of the Sequoias. Commencing in the fall of 1994 with the completion of the School of Education building, a new compressed video teleclassroom, with integrated multimedia teaching station, has been used to facilitate the exchange of regular academic courses between CSUF, CSU—Chico, and San Diego State on CSUNet. Additionally, the Joint Doctoral Program in Educational Leadership has acquired another CODEC unit for courses originating from several University of California campuses A video conferencing room system also has been added for special courses, conferences, and meetings within the CSU. Some 40 video conferences per semester on academic and support issues have been conducted since the fall of 1994. Future plans call for collaboration with Pacific Bell's statewide Knowledge Network to the public schools.

Education 187

The Education 187 classroom is a 48-seat facility used for distance learning courses by microwave and compressed video (See Appendix). This medium capacity classroom incorporates a multimedia teaching station and control booth area. Movable student seating allows for a variety of small group and collaborative learning exercises. The multimedia teaching station allows the instructor to access a variety of software and presentation programs directly, on a School of Education server, or through the campus-wide network. The teaching station is supplemented with three classroom cameras, a document camera, and Elmo slide-to-video converter. Images are displayed on large screen monitors and may be transmitted to remote learning sites by compressed video using a PictureTel unit. A fiber-optic feed to the main campus distribution facility in the Speech Arts Building provides full-motion, two-way video and audio. In classroom audio is supported by a gated Shure submixer and a 16-input and 4-output Mackie audio mixer as well as a 6-line Confer audio-conferencing telephone bridge with the remote "Director" option. In January, 1996, a Fujitsu compressed video unit was added to this classroom in support of a second remote classroom at the College of the Sequoias. This unit is part of a

Fujitsu demonstration for full voice, video and data digital service to the community college by a proprietary Integrated System Digital Service (ISDN) Primary Rate Interface (PRI) line.

Education 172

The Education 172 facility will be used for a wide variety of synchronous and asynchronous distance learning courses, on-campus multimedia classes, and training courses (See Appendix). The medium capacity 84-seat, tiered classroom and control room will accommodate four cameras, multimedia presentation by Video/Data Projection, and simultaneous distribution by campus fiber-optic and coaxial cable networks as well as by compressed video. As the room approaches a small auditorium, a primary large screen display will be placed in the center of the room with two smaller screen on either side, representing off-campus students and graphic images for presentation and discussion. Sound prescription would be supported with a multiple input, gated audio mixer and a stereo public address system. The instructor's station will support both Macintosh and Windows operating systems and will have 24 megabytes of internal memory. Not only will the computer have access to the traditional Kodak Photo Compact Disc (CD) formats and network sources, but it will have entry to a video server with Motion Picture Expert Group (MPEG) decoding on a dedicated subnet. This will allow unlimited access to a video-on-demand library of educational materials which will be developed.

California State University, Hayward (CSUH)

Four, state-of-the art, two-way distance learning classrooms and a two-way video conference room were recently installed on the CSUH campus and at CSUH's Contra Costa satellite campus (See Appendix). These facilities are integrated through a campus digital video switch and local multipoint unit which in turn is connected to the CSUH, state-wide, multiple T1 trunk and Asynchronous Transfer Mode (ATM) networks. ISDN dialup services and Sprint meeting room connections provide national and world-wide connectivity to these facilities.

Currently, CSUH offers 21 distance learning classes each quarter. Courses are conducted between the CSUH main campus and the satellite campus in Concord, between campuses throughout the 22 campus CSU system and with University of California sites, including the Lawrence Livermore Laboratory. Courses are offered in a variety of disciplines ranging from introductory classes in Psychology and Art History, to upper division Accounting, Nursing, Political Science, Telecommunications, and graduate programs in Multimedia, Finance, and Genetics. The Distance Learning facilities are also used extensively for administrative video conferencing, interviewing, workshops and special seminars.

The CSUH rooms utilize full, two-way video and audio capability. Each custom room is fully multimedia capable in both Macintosh and IBM-compatible platforms and include touch-panel remote control systems, video to slide converters, video overheads, large screen displays, and high resolution data and video projection. The rooms accommodate 100, 45, 35, and 20 students. The conference facility has a five to ten person capacity. The design of these facilities has received national recognition. In addition, CSUH has attracted international visitors to these facilities seeking design solutions for two-way video communications. The most notable of these visitors was the Director of Telecommunications for the People's Republic of China.

The CSUH system is based on a compressed video format, utilizing dedicated T1 lines and dialup ISDN. Compression Video Labs Rembrandt II, Standards Plus, and Radiance CODEC units are used.

Conclusions

To make effective use of two-way interactive distance education and multimedia systems, classroom design should have the highest priority. A properly designed classroom will enhance content objectives and increase acceptance of these types of instructional delivery. What is essential is that planners determine the optimum mix and configuration of teaching facilities for the future prior to beginning any classroom project. Consideration must be give to site and spatial relationships, imaging, lighting, electrical and telecommunication systems, mechanical systems, and most importantly, acoustics. With the advent of multimedia imaging devices, the distinction between the computer screen and the television monitor will probably soon disappear, and classrooms will have all purpose, individual student display and listening stations. These and other technological advances demand flexibility in personal student environments. The teacher-learner relationship with more faculty-student collaboration and small group projects or research continues to evolve. Educational and technological evolution focuses increased attention on the design of classrooms and instructional delivery in meeting the individual needs of students for generations to come.

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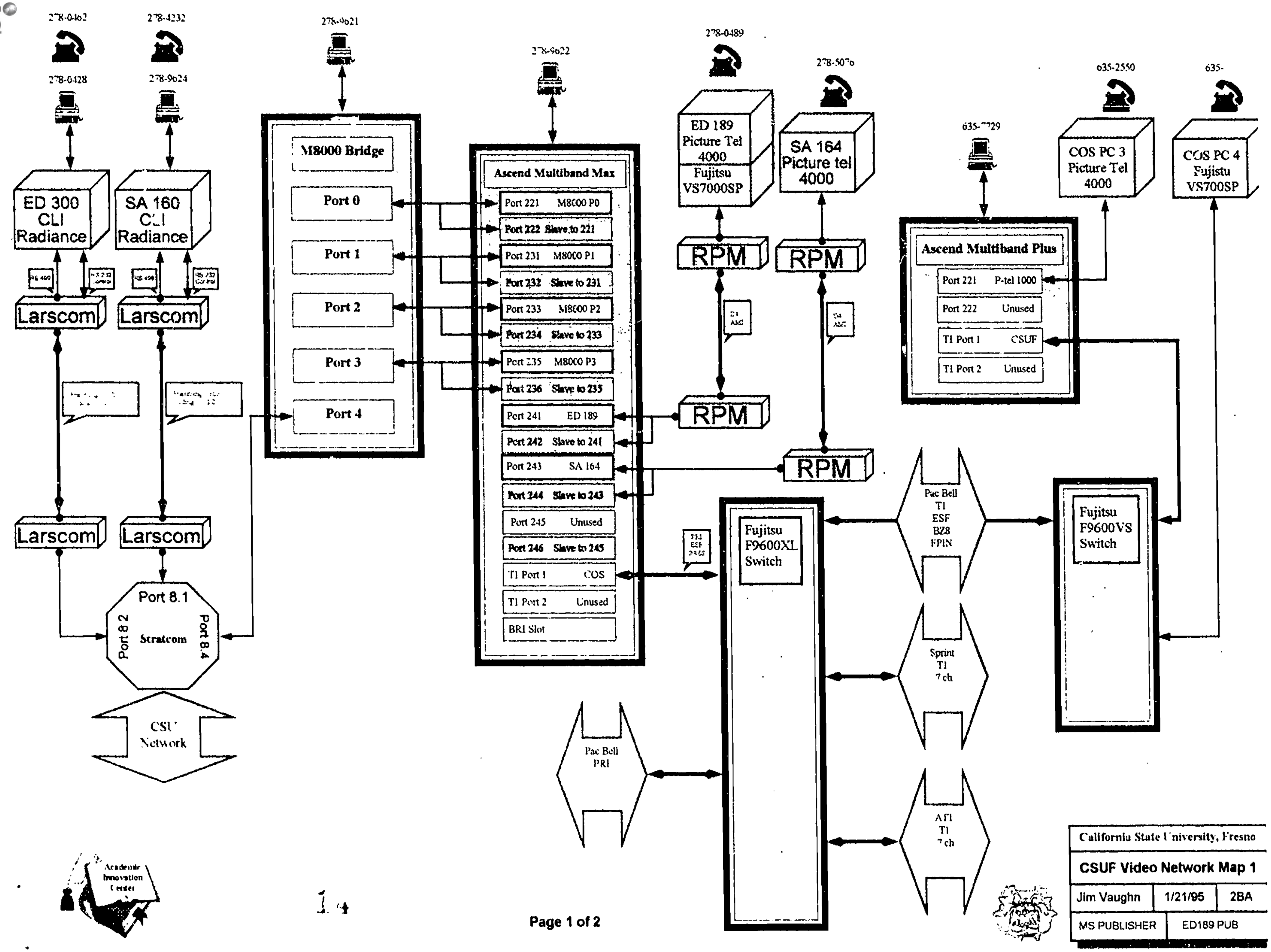
Appendix



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Education Room 187/89
Equipment

Image Displays

4-27" Sony Monitors (Pair mounted on left and right front of classroom; inbound & outbound video)
27" Sony Monitor (Centered at rear of classroom; inbound/outbound video)
2-9" Monitors, Panasonic S901 (Instructor's Station; inbound & outbound video)

Instructor's Station

Personal Computer, Macintosh 8100/80 AV
- 16 MB internal memory
- 500 MB hard disk
- 600X400 pixel display with 256 color
- Stereo Sound Card
- NTSC & S-Video & Audio Output
- CD-ROM Drive (Kodak Photo CD format w/audio CD)
- Laser Disc Player, Sony LaserMax
- Ethernet Interface

Document Camera, Canon RE-650 Video Visualizer
Wireless Microphone, Shure L3

Classroom Operator Station in Control Booth (Ed. 189)

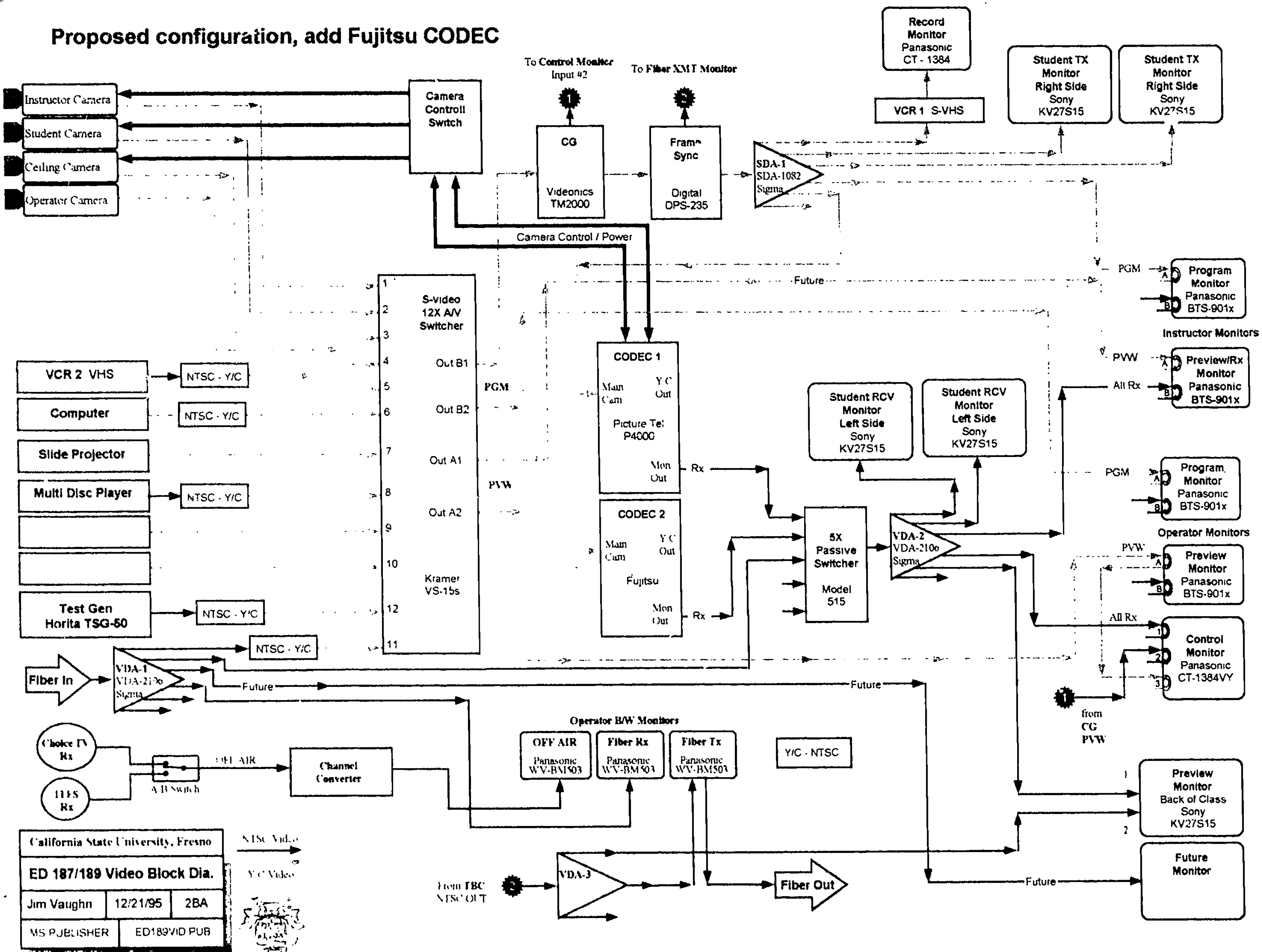
Video Conferencing Audio/Video Control, PictureTel 4000
- Instructor Camera, Rear Ceiling mounted PictureTel
- Student Camera, Front Ceiling mounted PictureTel
- 35mm Slide-to-Video Scan Converter, Elmo TRV-350
- S-VHS VCR 1 (playback), Sony SVO-1450
- Instructor's Computer Workstation input

Video Switcher, Kramer VS-15S
- all video sources above and below
- remote site video from PictureTel
- Video Titlemaker, Videonics 2000

S-VHS VCR 2(record), Panasonic AG 1950
Source Monitors, 5" Triple Monitors, Panasonic WV-BM503
Program and Preview Monitors, Panasonic BTS-901
Audio SubMixer with voice-activated inputs for Instructor and Student Microphones, Shure SCM 810
Audio Main Mixer, 16-input & 4-output, Mackie LM 3204
Audio ducking, Aphex
6-line Telephone Bridge, Confer with Director Option
Terminal Equipment
- Frame Storage Correction, Digital DPS-235
- Test Generator (Audio/Video), Herita TSG-50
- VU audio levels, Logitek Bright-VU
- Audio/Video Distribution Amps, Sigma VDA-2106 (baseband distribution)
- Fiber-optic Distribution, Grass Valley Wavelink 3290

Stereo Public Address Audio, Pioneer SX 303R

Proposed configuration, add Fujitsu CODEC



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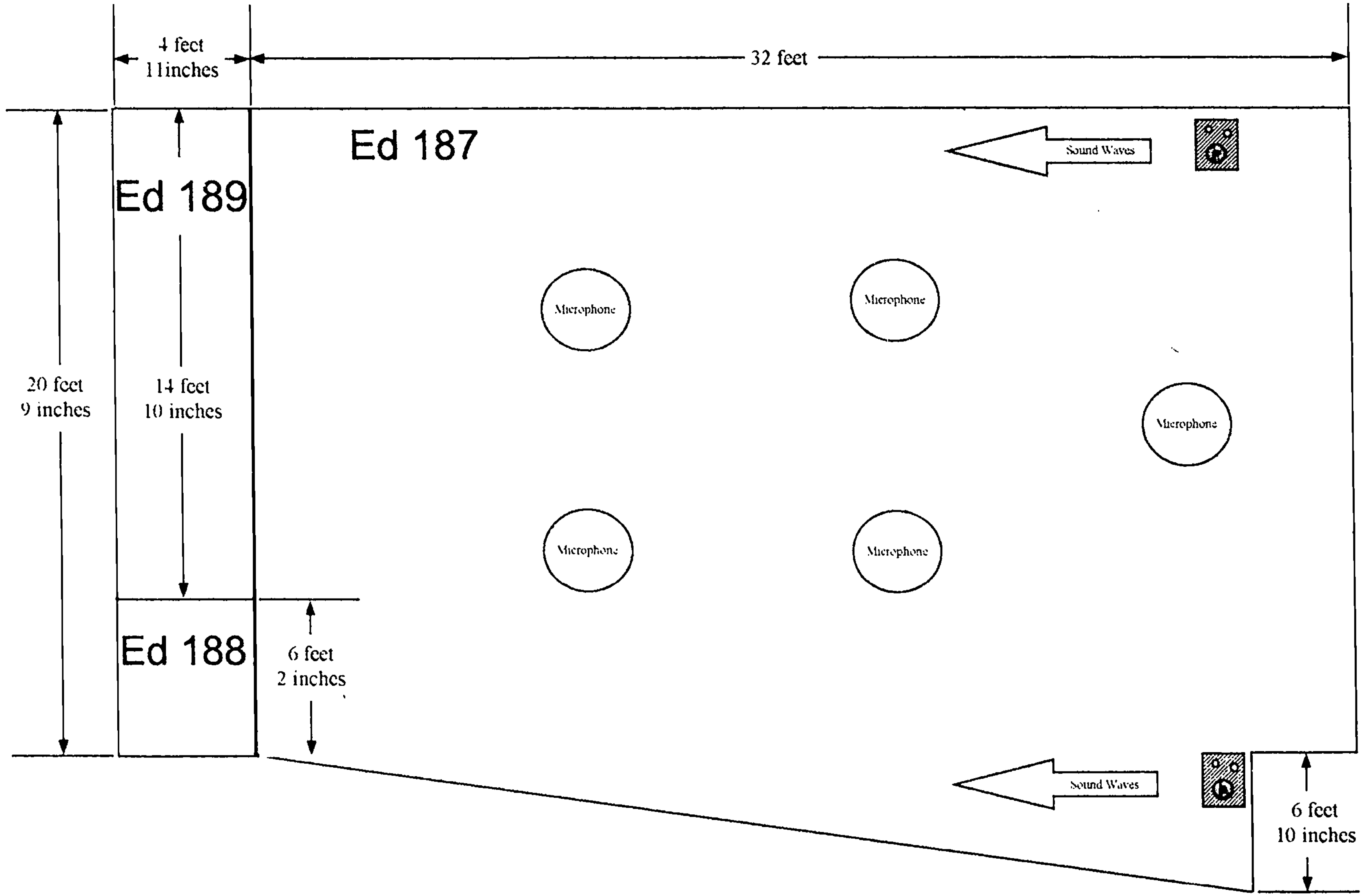

California State University, Fresno		
ED 187/188/189 Floor Plan		
Jim Vaughn	8/21/95	2BA
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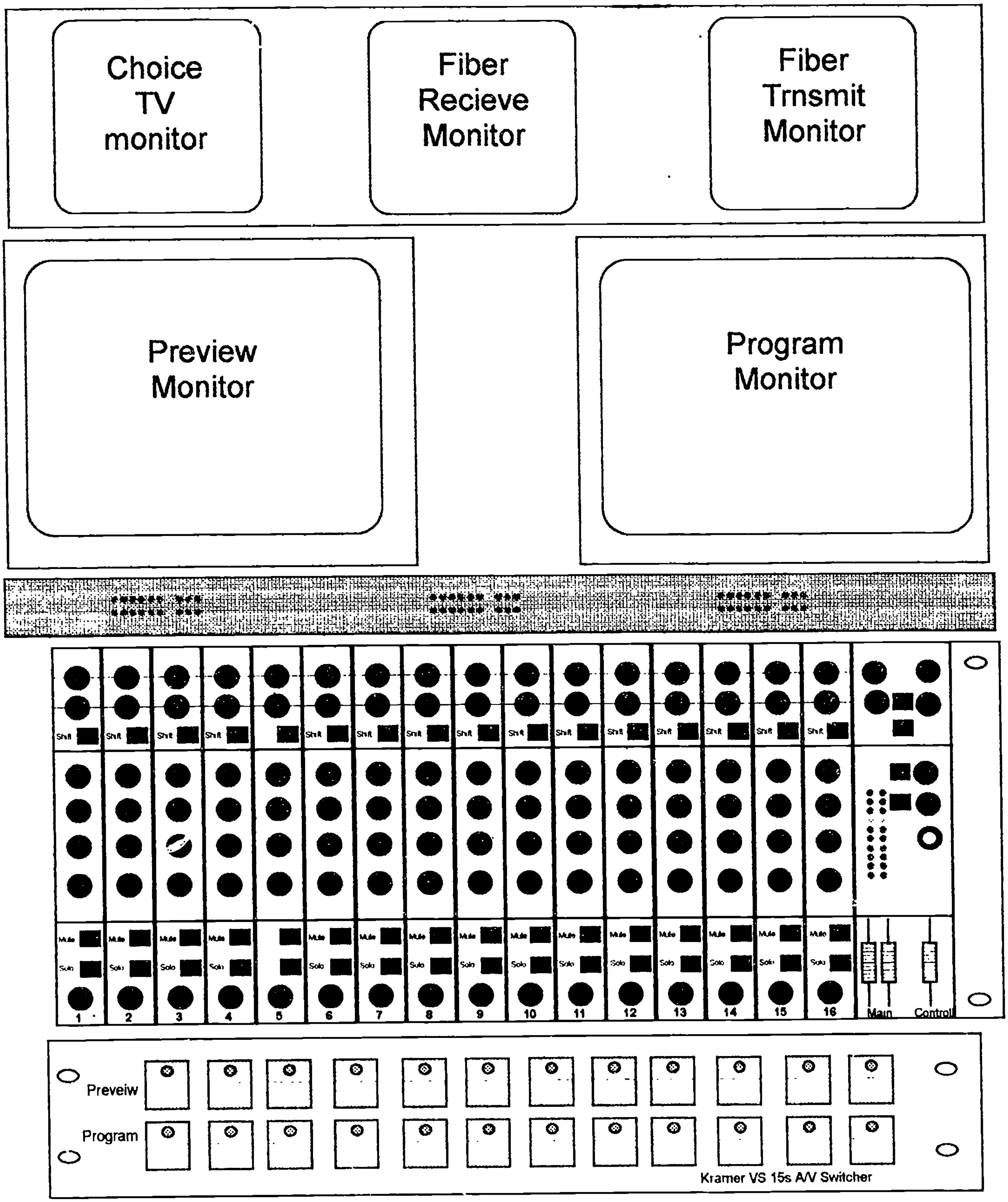
Academic Innovation Center



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ED 189 Equipment Rack 1		
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California State University, Fresno

ED 187/189 Kramer Layout

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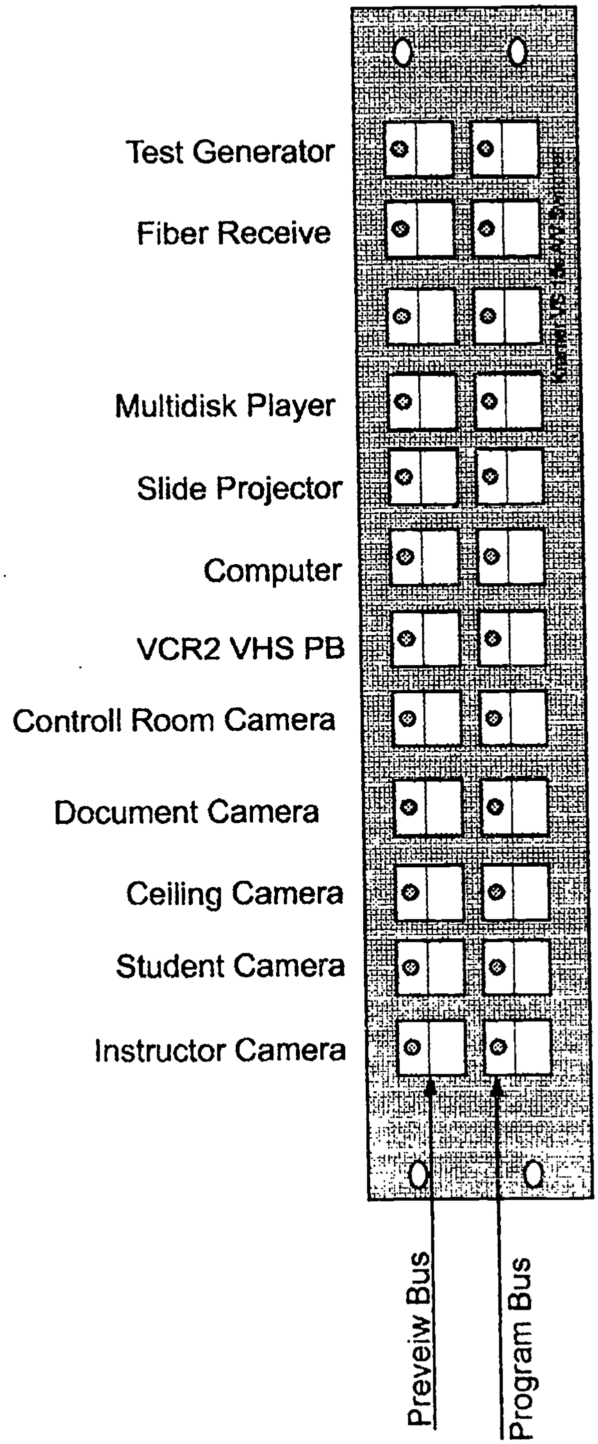
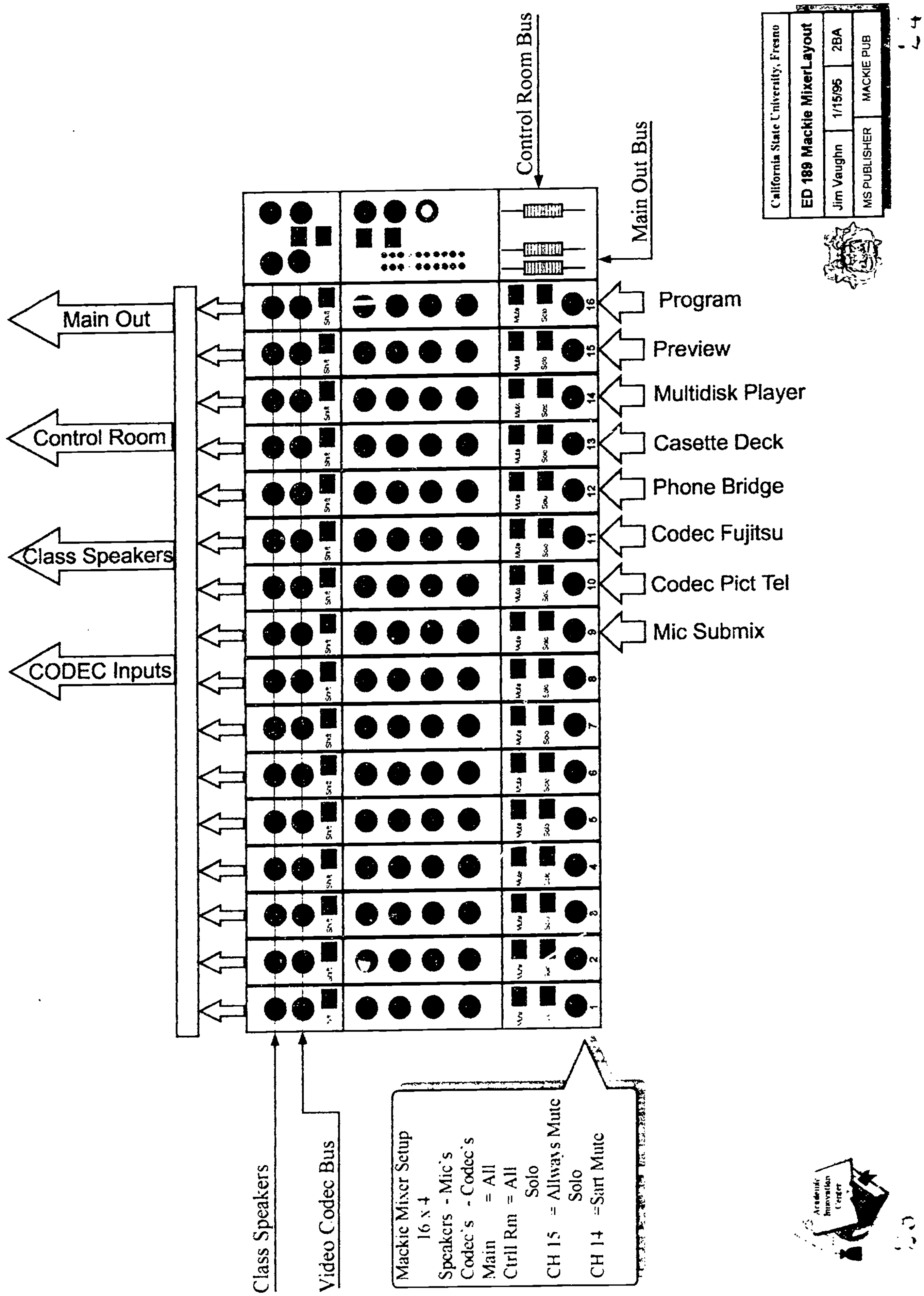




California State University, Fresno
ED 189 Mackie MixerLayout
Jim Vaughn
1/15/95
2BA
MS PUBLISHER
MACKIE PUB
Control Room Bus
Main Out Bus
Main Out
Control Room
Class Speakers
CODEC Inputs
Program
Preview
Multidisk Player
Casette Deck
Phone Bridge
Codec Fujitsu
Codec Pict Tel
Mic Submix
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Class Speakers
Video Codec Bus
Mackie Mixer Setup
16 x 4
Speakers - Mic's
Codec's - Codec's
Main = All
Ctrl Rm = All
Solo
CH 15 = Allways Mute
Solo
CH 14 =Sart Mute

Education Room 172
Equipment

Image Displays

Center Screen (10'x10' video/data projection, screen existing)
2-42" Monitors (one on either side of Center Screen)
2-42" Monitors (Centered at rear of classroom; inbound & outbound video)

Instructor's Station

Dual Platform Personal Computer(s) PC/Windows/Macintosh

- 24 MB internal memory
- 2 GB hard disk with SCSI AV interface
- Removable Hard Drive
- 600X400 pixel display with 256 color (minimum)
- Stereo Sound Card
- NTSC Video & Audio Output
- Display screen
- Preview Screen
- CD-ROM Drive (Kodak Photo CD format w/audio CD)
- Laser Disc Player
- Ethernet Interface
- Video Server Interface

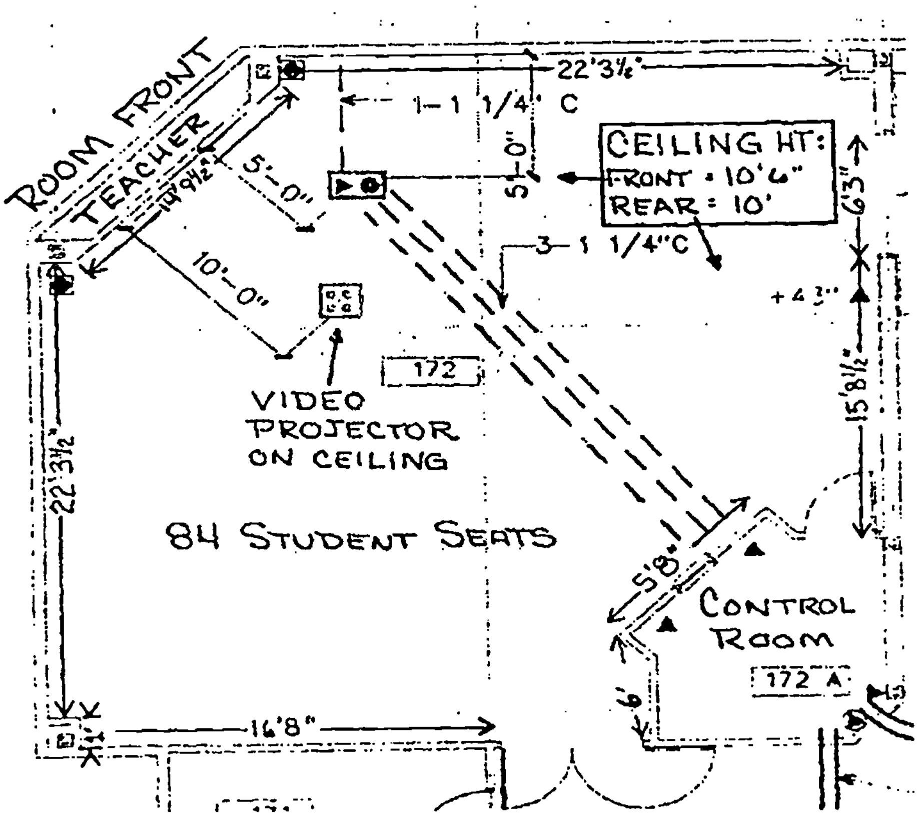
Video Conferencing Audio/Video Control

- Document Camera
- Instructor Camera
- Student Camera (Left)
- Student Camera (Right)
- 35mm Slide-to-Video Scan Converter
- S-VHS VCR 1 (playback)
- Computer Workstation

Classroom Operator Station in Booth (Switchable from Instructor Station)

- Video Switcher w/corner insert & chroma key
  - all video sources above and below
  - remote site video
- S-VHS VCR 2(record)
- Audio Mixer with voice-activated inputs for Instructor, Student Microphones & all audio sources as well as remote site audio ducking
- 5-line Telephone Bridge
- Terminal Equipment
  - Frame Storage Correction
  - Test Generator (Audio/Video)
  - Waveform Monitor & Vectorscope
  - VU audio levels
  - Audio/Video Distribution Amps. (fiber & baseband distribution)
- Stereo Public Address Audio

FAX machine



Education 172/72A

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BLOCK DIAGRAM
EDUCATION BUILDING
CALIF STATE UNIV. FRESNO

M J FEIST	17NOV

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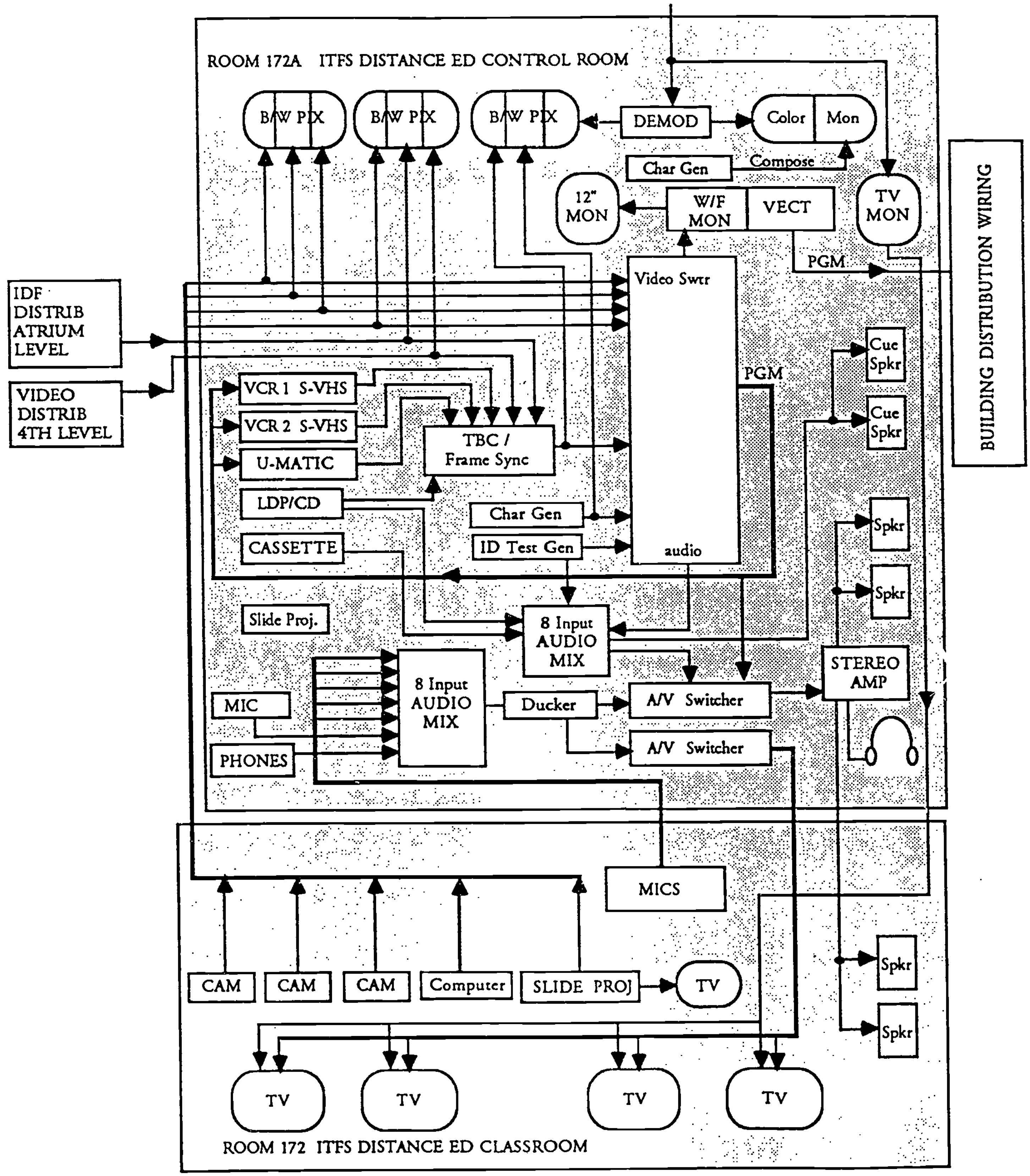

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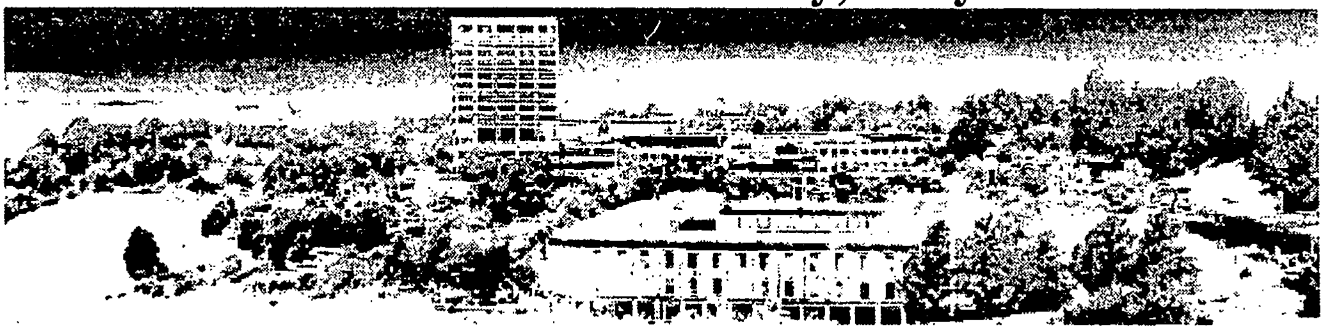
California State University, Hayward



DISTANCE LEARNING CLASSROOM DESIGN FOR TWO-WAY COMPRESSED VIDEO

1996 AECT NATIONAL CONVENTION
Indianapolis, Indiana
FEBRUARY 14-18

Roger Parker, Director
Instructional Media Center/Distance Learning
California State University, Hayward
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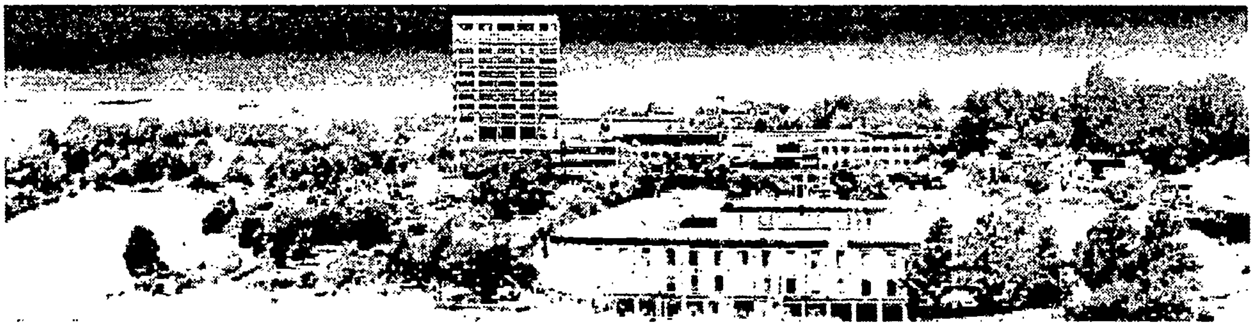
California State University, Hayward
Distance Learning



Four, state-of-the-art, two-way Distance Learning classrooms and a two-way video conference room were recently installed on the California State University, Hayward (CSUH) main campus and at CSUH's Contra Costa satellite campus. These facilities are integrated through a campus digital video switch and local multipoint unit which in turn is connected to the CSUH, state-wide, multiple T1 and ATM networks. ISDN dialup services and Sprint meeting room connections provide national and world-wide connectivity to these facilities.

Currently, CSUH offers 21 distance learning classes each quarter. Courses are conducted between the CSUH main campus and the satellite campus in Concord, between campuses throughout the 22 campus CSU system and with University of California sites including the Lawrence Livermore Laboratory. Courses are offered in a variety of disciplines ranging from introductory classes in Psychology and Art History, to upper division Accounting, Nursing, Political Science, Telecommunications. Graduate programs in Multimedia, Finance and Genetics are also offered.

The Distance Learning facilities are also used extensively for administrative video conferencing, interviewing, workshops and special seminars.

The CSUH rooms utilize full, two-way video and audio capability. Each custom room is fully multimedia capable in both Mac and IBM-compatible platforms and include touch-panel remote control systems, video to slide converters, video overheads, large screen displays and high resolution data and video projection. The rooms accommodate 100, 45, 35 and 20. The conference facility has a five to 10 person capacity. The design of these facilities has received national recognition. In addition, the rooms have attracted international visitors seeking design solutions for two-way video communications.

The CSUH system is based on a compressed video format, utilizing dedicated T1 lines and dialup ISDN. Compression Video Labs Rembrandt II, Standards Plus and Radiance codec units are used.

For additional information regarding Distance Learning at California State University, Hayward, contact:

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2/96

DISTANCE LEARNING CLASSROOMS at California State University, Fresno & Hayward

The Presenters...

- **Russ Hart**
  California State University, Fresno
  russ_hart@csufresno.edu

- **Roger Parker**
  California State University, Hayward
  rparker@csuhayward.edu

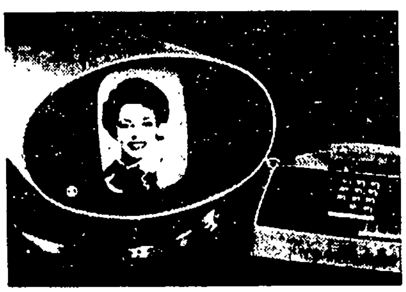
Topics

1. Broad advice on room selection and modification
2. Acoustic guidelines
3. Lighting guidelines
4. Classroom layouts
   Seating and podium choices
   Microphone alternatives etc.
5. Hardware choices/Control systems
6. The CSUH/Fresno Experience

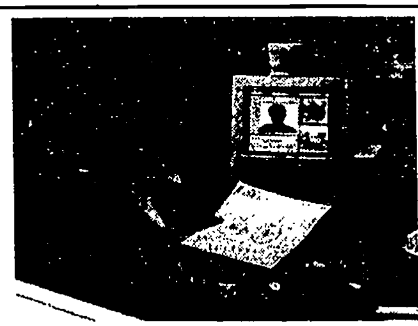
A Compressed Video Primer

DISTANCE LEARNING CLASSROOMS at California State University, Fresno & Hayward

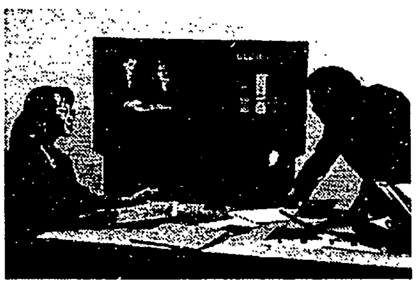
1964 AT&T VideoPhone



1995 Desktop Conferencing



Gallery Conferencing Unit



~~KODAK~~ CODEC

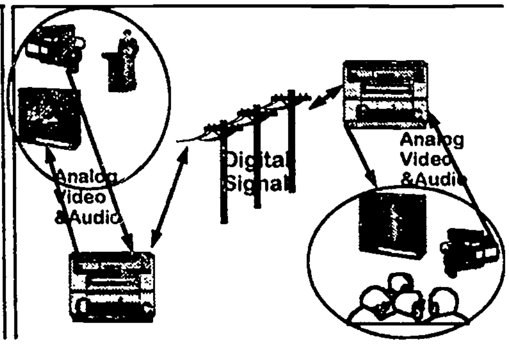
Compression/Decompression

Two-way video and audio transmission via digital conversion & compression

Variety of Manufacturers

- •CLI
- •PictureTel
- •Northern Telecom
- •GPT/BT etc. etc.

Codec Two-Way Communications



T1 Telephone Service

T1 is equivalent to 24 telephone lines or 1.5 mbs

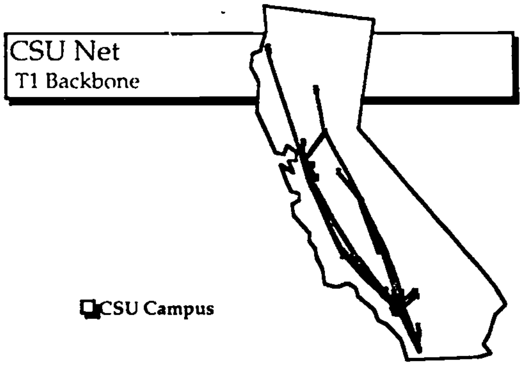
1/4 T1 = 6 lines = 384 kbs
1/2 T1 = 12 lines = 768 kbs

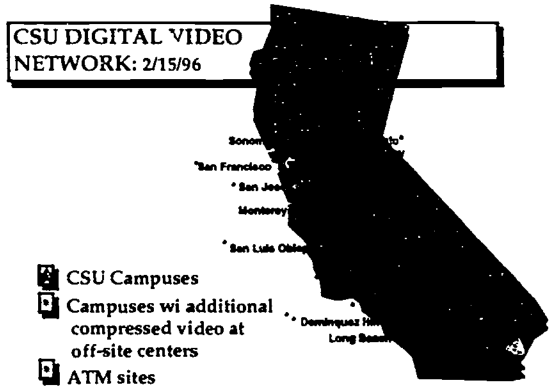
- •Pay monthly by the distance (Hayward to Concord @ 35 miles = @$1000 per mo)
- •Always available for use:
- •Data /Video /Voice

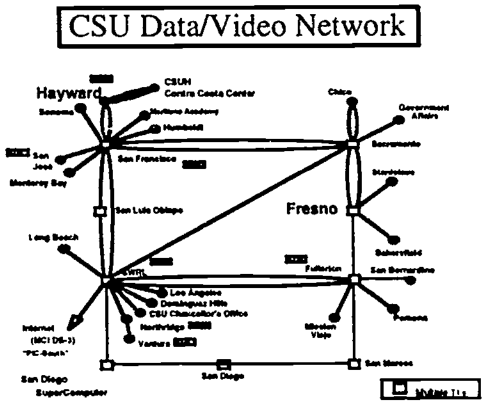
The Digital Network

The California State University Network

CSUNet







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Classroom Design

Topics

1. Room selection and modification
2. Acoustic guidelines
3. Lighting guidelines
4. Classroom layouts, Seating and podium choices, Microphone alternatives etc.
5. Hardware choices/Control systems
6. The CSUH/FRESNO Experience

Project Elements

- Room Selection
- Room Modifications
- Electronics
- Codec system

Room Selection

- Avoid windows
- Consider security
- Avoid noisy locations
- Near media support services
- 12' ceilings (9' may be OK for smaller rooms)
- 30 sq feet per student (CSUH=20)
- HVAC equipment location outside room boundaries
- Asbestos removal?

Room Modifications

- Layout/Seating and Displays
- Acoustic Treatment
- Lighting Approaches

Room Layout & Design

- Studio vs Classroom
- Gallery Unit
- Modified Gallery
- Custom
  - Do it yourself
  - Use a "Room Integrator"

Room Layout *contd.*

- Moveable vs fixed seating
- Conference vs formal lecture
- Fixed presentation vs mobility
- Standing vs sitting teaching location
- Raised platform
- Overhead graphics camera vs presentation stand (Elmo)
- Technician or faculty operated
- Desks (20" deep recommended)
- Rows (4' front to back)

Acoustic Design

Your Mission:

Eliminate exterior/interior noise and reduce interior echo.

Acoustic Elements

- Room Location
- Room Shape
- Floor Treatment
- Ceiling Treatment
- Wall Treatment
- Doors

Acoustic Guidelines

- Avoid locations near compressors/air handling systems, elevator motors etc.
- Flexible/wrapped ducting
- Avoid heavily trafficked areas
- Wall treatment (1" fiberglass wi 6lb density- NRC.70)
- Ambient room noise should not exceed NC25-35dba at 500hz.
- Reverberation time (RT) should not exceed 0.5 seconds at 500hz.
- Carpeted floor wi pad

Acoustic Guidelines *contd.*

- Echo Cancellation
  - AERL
    Acoustic Echo Retrun Loss
  - ERL
    Echo Return Loss
- Other gems for the technically proficient:
  - The Echo Canceller needs to hear the audio al the time.
  - One mic must always be active.
  - Decay to 1/60th, the original energy, within 60ms.

Lighting Guidelines

- Dimmable zoned lighting?
- Extra lighting on faculty teaching area
  - Backlights and Highlights
- Control lighting on projection/displays
- Fluorescent light
  - 3500 lumens
  - 80-100 footcandles at shoulder level
  - 5000 kelvin temperature
- Louvered 45 degree fixtures?
- Backlighting/separation lighting
- Wall washes

Color Scheme

- Mid- spectrum Colors
  - tans, light blues or grays
- No patterns
- Non-glare surfaces

Video Display Sizes

- Normal television 
  - 8X diagonal
- Computer 
  - 4x diagonal

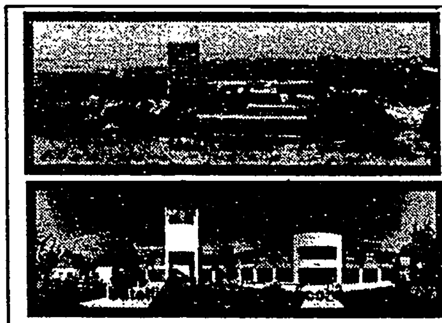
Program/Display Sources

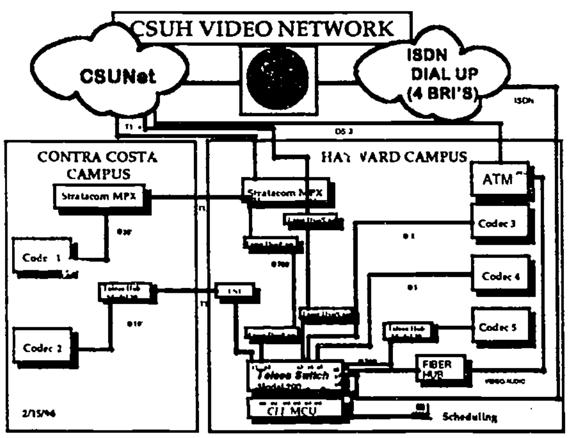
	Transmit	Display
Faculty camera (s)	Yes	No
Graphics/overhead camera	Yes	Yes
Audience camera	Yes	No
VCR	Yes	Yes
Slides	Yes	Yes
Computer	Yes	Yes
Distant site motion	No	Yes
Distant site still	No	Yes

The CSUH Experience

DISTANCE LEARNING at California State University, Hayward

CSUH

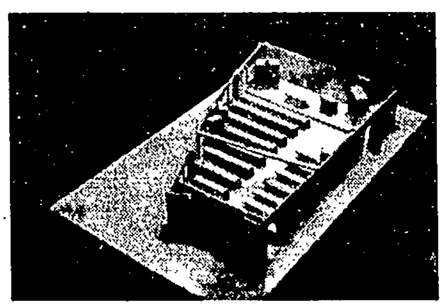




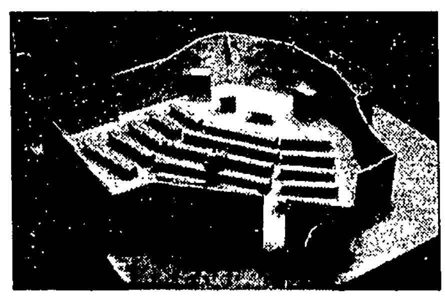
Classroom Requirements

- ☑ Large capacity room
- ☑ Include computer/multimedia presentations
- ☑ Student/non technical operator
- ☑ Function as a regular classroom with no operator
- ☑ Double as a receive site
- ☑ Also serve as a conference facility
- ☑ Two way video
- ☑ Full duplex audio

Model of LB231

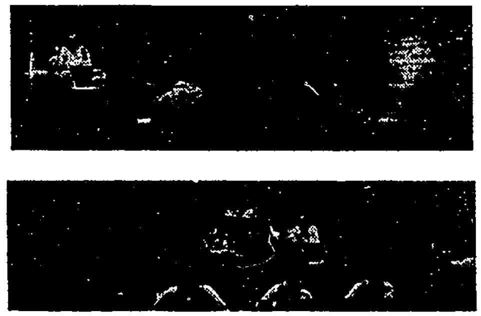


CSUH Distance Learning Classrooms: Model for Mi2106

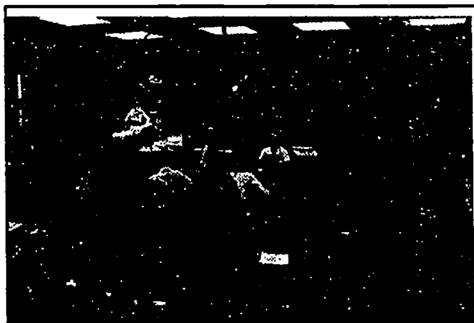


Mi2106 In Actiom

Li2195: Front and Rear Views

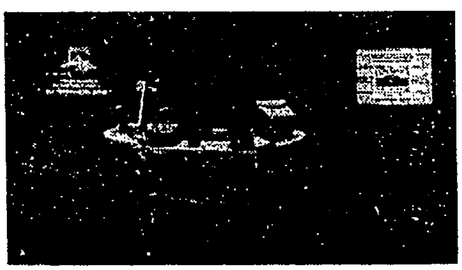


Li 2195:Student Response from Remote Site



Li2195 Console

LB150



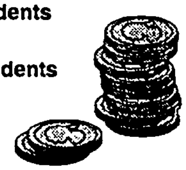
LI231: Console

Room One Costs (90 seats)

- **Room modifications**
  - 85,000.00
- **Electronics**
  - 125,000.00
- **Codec**
  - 60,000.00

Room Con$truction

- **CSUH #1 : 90students**
  - 85,000.00
- **CSUH #2 : 35 students**
  - 70,000.00
- **Contra Costa #1: 50 students**
  - 89,000.00
- **Contra Costa #2: 35 students**
  - 90,000.00



Fall Distance Learning Courses: Year One

- Art 3410: Electronic Media Seminar
- HDev 4870: Selected Topics
- Mktg 3420: Sales Analysis and Management
- MCom 4500: Women in Media
- Nur 4207: Clinical Nursing
- PoSc 3150: Politics of California
- Rec 3800: Intro to Therapeutic Recreation
- WoSt 3530: Women and Their Bodies

DISTANCE LEARNING at California State University, Hayward

The Electronics

DISTANCE LEARNING
at
California State University,
Hayward

Electronic Details

- Displays
  - size, location, quantity, RGB
- Microphones
  - ceiling, desktop, push-to-talk, VOX
- Control System
  - studio switcher, touch panels (Crestron/AMX), Elmo
- Cameras
  - three chip/single chip, autofocus, Parkervision
- Input Devices
  - graphics camera, vcr, NTSC converter, slide-video

Or

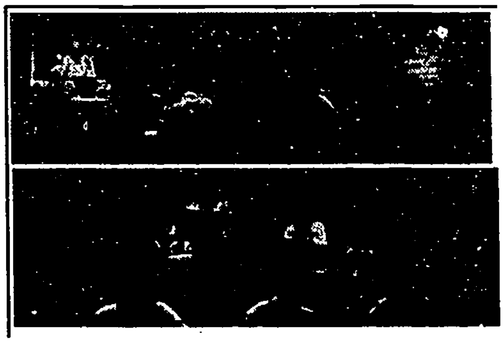
Forget it all and buy a turnkey Gallery UNIT

Gallery Conferencing Unit

Large Lecture vs Conference/Seminar

Large Lecture	Conf/Seminar
Formal presentations	Casual to formal
Primarily one-way	Interactive / shared
Intermittent /controlled interruptions	Open discussion
Single presenter	None to multiple
Medium to large groups	Small groups

Gallery Concept in Classroom



Large 60" Consumer Monitors

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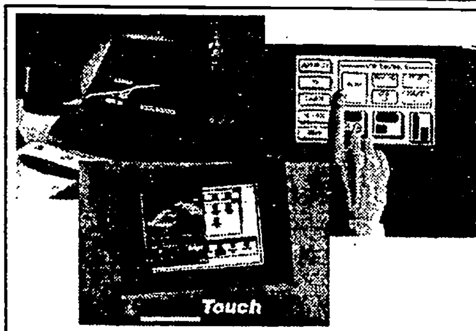
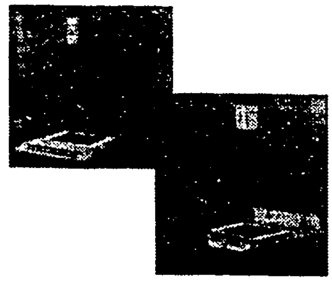
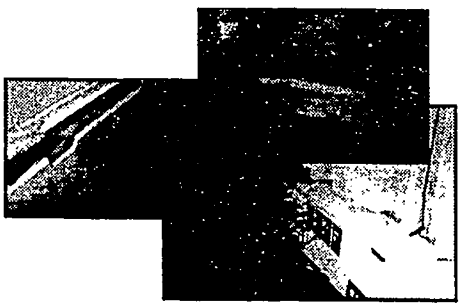
Touch Panel Controls



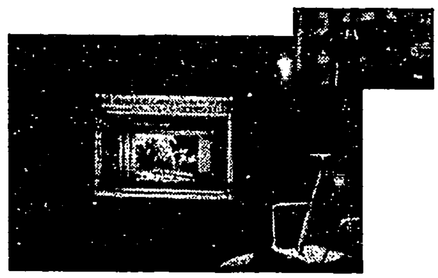
Graphic Stands



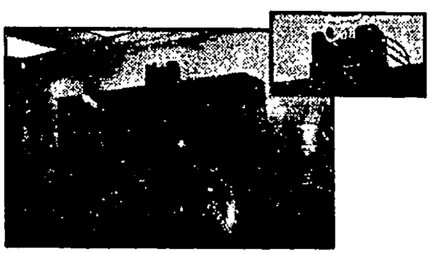
Raceway Solution



Camera Choice

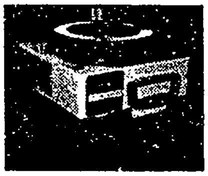


Camera Choices

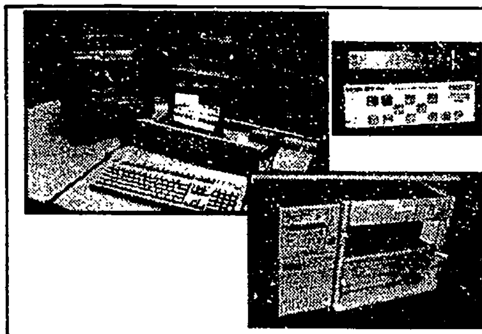


Operator's Console

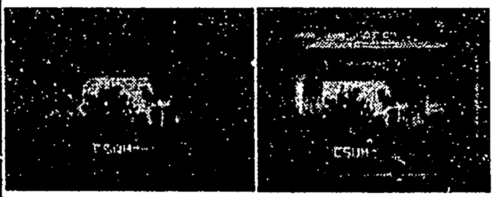
Accessory Rack wi Elmo Slide to VideoUnit



Computers



Composite vs RGB



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Desktop Conferencing

DISTANCE LEARNING

at

California State University, Hayward